Technical Information

TI 11M12A01-01E

ZR22G, ZR402G
Direct In Situ
Zirconia Oxygen Analyzer
(Applications Volume)

EXAxi

YOKOGAWA
Yokogawa Electric Corporation

TI 11M12A01-01E
1st Edition, May 2004 (KP)

ZR22G, ZR402G
Direct In Situ
Zirconia Oxygen Analyzer
(Applications Volume)

TI 11M12A01-01E 1st Edition

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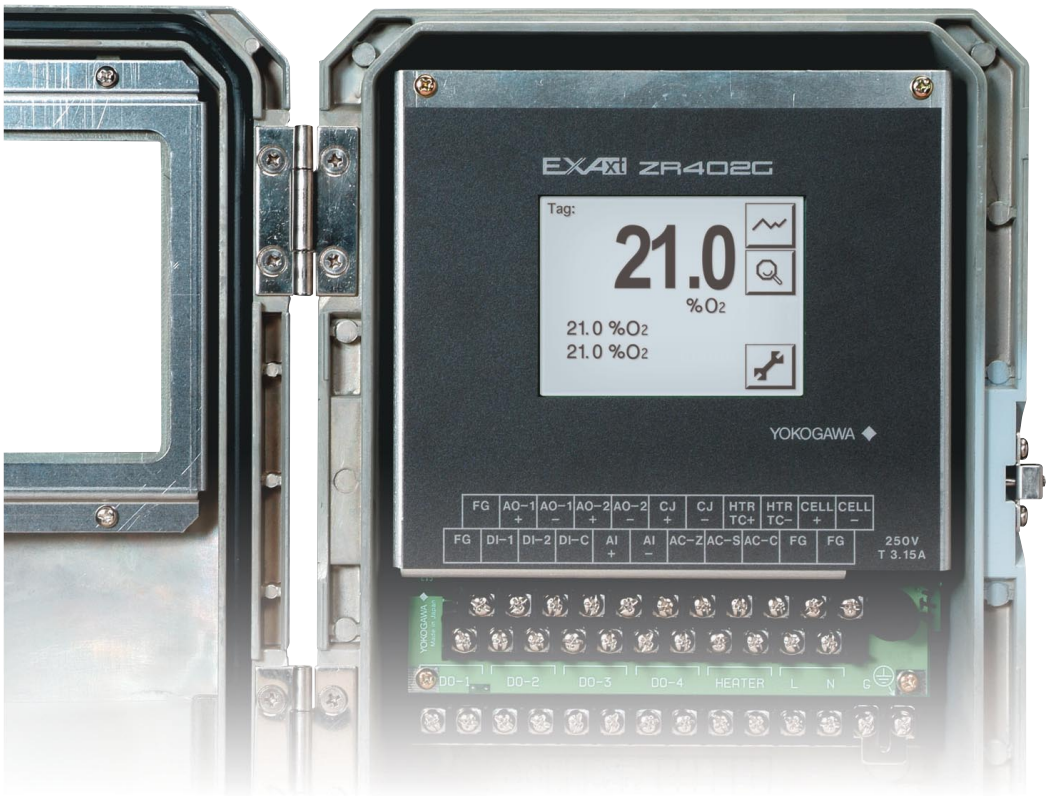
1. Overview

The EXAxt Zircon Oxygen Analyzer (Model ZR402G) is used to monitor and control the oxygen concentration in combustion gases, in boilers and industrial furnaces, for wide application in industries which consume considerable energy—such as steel, electric power, oil and petro-chemical, ceramics, paper and pulp, food, or textiles, as well as incinerators and medium/small boilers. It can help conserve energy in these industries. The ZR402G also contributes to preservation of the earth's environment in preventing global warming and air pollution by controlling complete combustion to reduce CO_2, SOx and NOx.

ZR22G Detector uses a high-reliability Zirconia sensor, and its heater assembly can be replaced on site. The detector is mounted, for example, on the wall of a flue and can measure the gases directly.

For use in combustion gases at temperatures up to 1400°C, choose the general-use 0.15m long detector, which is combined with ZO21P-H, the high-temperature probe protector. The converter is equipped with an LCD touch screen which has various setting displays, a calibration display, oxygen concentration trend display, with easier operation and improvement of display functions. The converter is equipped with various standard functions such as measurement and calculation as well as maintenance functions including self-test. Analyzer calibration can also be fully automated— and ZR40H, an automatic calibration unit, is available. Choose the detector version which best suits your needs so that an optimal combustion control system can be obtained.

Use this TI as a system selection guide and application note.


EXAxt ZR402G
Tag:
21.0
%O2
21.0 %O2
21.0 %O2
YOKOGAWA
FG AO-1 + AO-1 - AO-2 + AO-2 - CJ + CJ - HTR TC+ HTR TC- CELL + CELL -
FG DI-1 DI-2 DI-C AI + AI - AC-Z AC-S AC-C FG FG
250V T 3.15A
DO-1 DO-2 DO-3 DO-4 HEATER L N G

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2. Installation Guide

2.1 Selecting an Installation Site

Improper installation of the detector may cause inaccurate measurement or damage in short-term service.

(1) Easy access for inspection and maintenance.

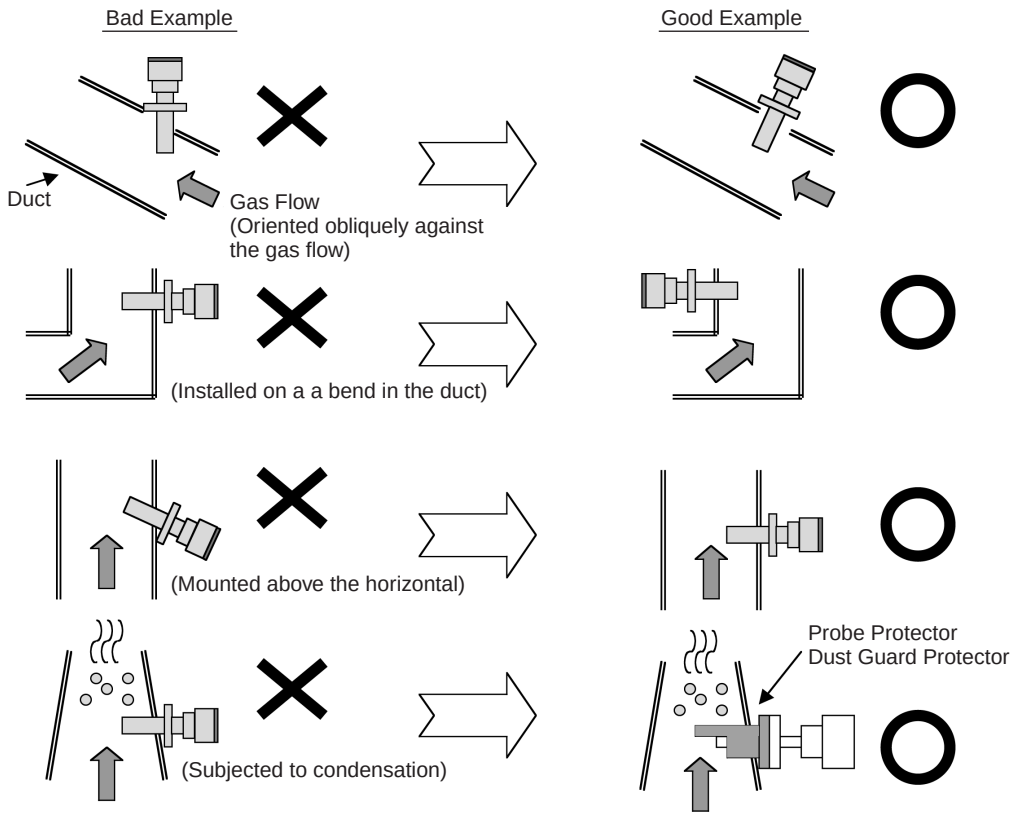
(2) Ambient temperature does not exceed 150°C, and the terminal box is not exposed to radiant heat.

(3) A clean environment free from corrosive gases.

(4) Minimum vibration.

Typical good/bad installation examples are shown below for your reference.

Instructions for installation



Installation Site of the Converter (in case of ZR402G)

1. Allows the operator to easily read the display and operated the keys.
2. Easy access for inspection and maintenance.
3. Ambient temperature does not exceed 55°C, and temperature variations are minimal.
4. Humidity is moderate (40 to 75% RH) and no corrosive gases are present.
5. Minimum vibration.
6. Near to the detector.
7. Not exposed to direct sun light.

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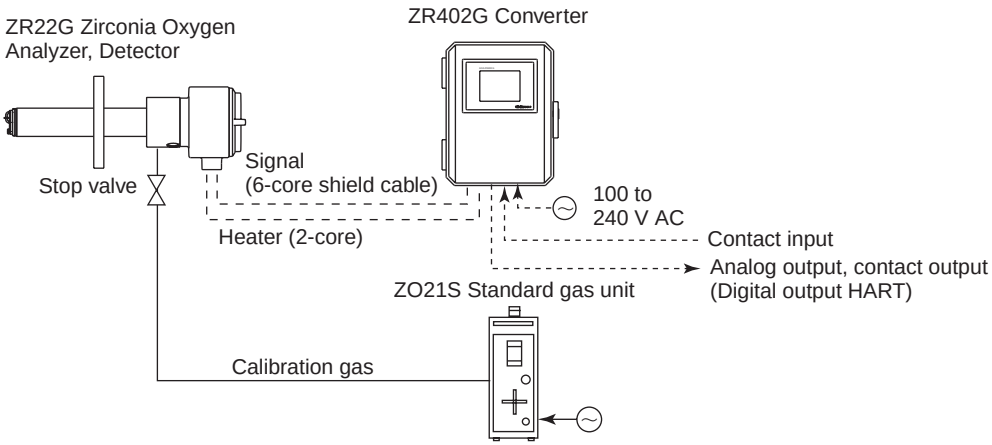
Instrument air is not available



①Install the stop valve securely so that the gas does not leak.
②Use the standard gas unit.
③Use a shielded cable for the signal line.

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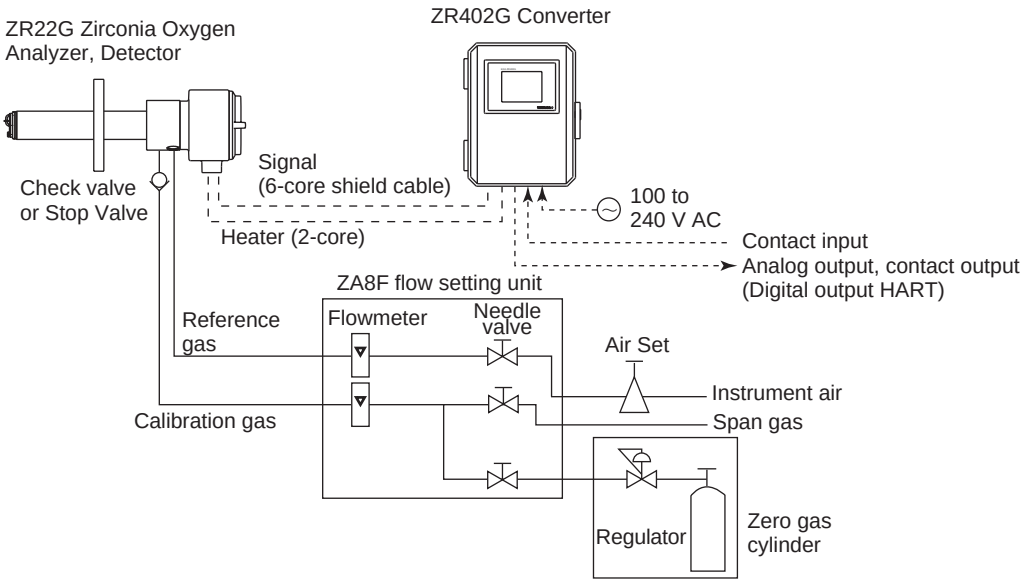
Instrument air is available



①Install the stop valve or check valve securely so that the gas does not leak.
②Use the flow setting unit and zero gas cylinder.
③Use a shielded cable for the signal line.

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3. System Configurations

This section includes two types of system selection guides for direct in situ zirconia oxygen analyzers. The reader should refer first the examples of system selection by application, and then examine the system block diagram and component device overviews.

3.1 ZR402G Direct In Situ Zirconia Oxygen Analyzer System Block Diagrams

(1) System Selection Examples, by Application

		General-purpose detector (0 to 700°C)		High-temperature detector (0 to 1400°C)	
		System types	Detector	System types	Detector
Common	Boiler (fuel oil, gas)	L1, L2, L3	D1, (D2)	H2, H3	
	Boiler (pulverized coal, fluidized bed)	L2, L3	D4	H2, H3	
	Boiler (bark, wood scrap)	L2, L3	D3, (D1)	H2, H3	
Iron & steel	Heating furnaces & soaking pits	L2, L3		H2, H3	D5
	Hot blast stove	L2, L3	D1	H2, H3	
	Coke ovens & annealing furnaces	L2, L3	D1, (D2)	H2, H3	D6, (D7)
	Sintering furnace	L2, L3	D1, (D4)	H2, H3	
Non-ferrous metals	Heating, sintering, & melting furnaces	L2, L3	D1, (D4)	H2, H3	D5, (D6)
Ceramic, brick, glass, & cement manufacture	Coal kilns (rotary & vertical)	L2, L3	D4, (D3)	H2, H3	(D5, D6)
	Cement kilns (cyclone outlet)	L2, L3	D4, (D3)	H2, H3	
	Glass melting furnaces (inside furnace)	L2, L3		H2, H3	D5, (D6)
	Glass melting furnaces (flue)	L2, L3		H2, H3	D5, (D6)
	Ceramic firing furnaces	L2, L3		H2, H3	D5, (D6)
Petroleum/ Petrochemical	Fired heaters & cracking furnaces	L2, L3	D1, (D2)	H2, H3	D5, (D6)
Pulp & paper	Black liquor recovery boilers	L2, L3	D3, (D4)	H2, H3	
Other	Electrical generating boilers (window box)	L2, L3	D1	H2, H3	
	Garbage & sludge incinerators	L2, L3	D1, D3	H2, H3	D5
	Oxyten enrichment equipment	L2, L3		H2, H3	D7*1

The meanings of these codes are explained on the pages that follow.

Note 1: Sampling system is required due to the high pressure.

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The symbols such as L1 and D1 used in “the Types of System Configuration and Detector” are only applicable in this Technical Information document for quick reference. They do not appear in other literatures including the bulletin, general specifications, or user’s manual.

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(2) System Block Diagram Types

○: Yes ×: None

System type No.	Name	Specification			Remarks
		Calibration			
		Simple type	General type		
			Manual	Auto	
L1	General-purpose	○	×	×	using standard gas unit
L2	General-purpose	×	○	×	using instrument air & zero gas cylinder
L3	General-purpose	×	×	○	using instrument air & zero gas cylinder
H1	High-temperature	○	×	×	using standard gas unit
H2	High-temperature	×	○	×	using instrument air & zero gas cylinder
H3	High-temperature	×	×	○	using instrument air & zero gas cylinder

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3.2 Selection According to Use

Examples of selection according to use	System type No.
For monitoring (package boilers, etc.)	L1/H1
For high precision measurement for control purposes, etc.	L2/H2
For auto calibration options	L3/H3

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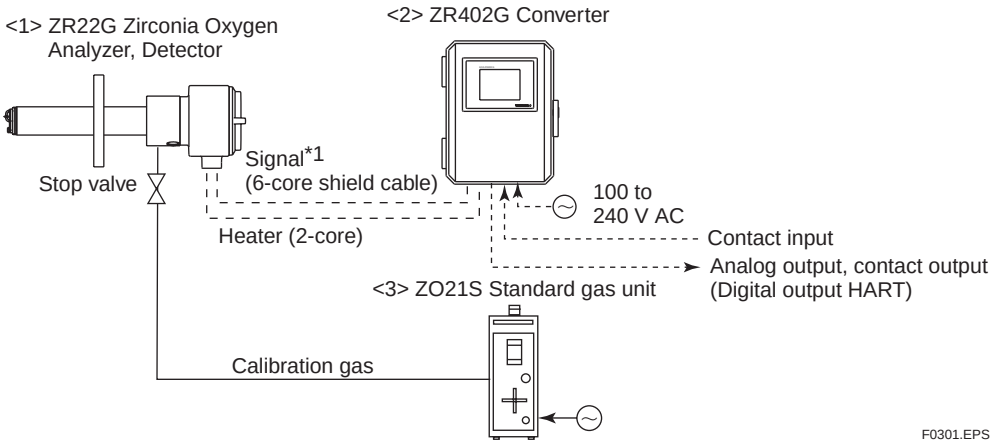
(1) Type: L1 (simple measurement system)



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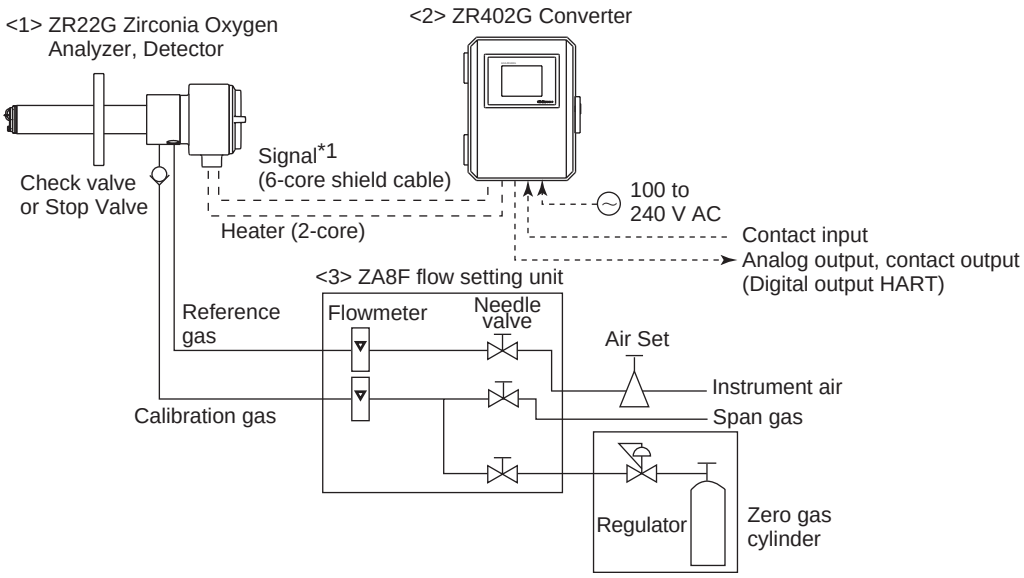
(2) Type: L2 (no auto calibration)



Note 1: Detector can be selected from among the following

No.	Check	Name	Sketch of shade
1		General-purpose detector (with check valve)	
2		Detector with probe protector (same as above)	
3		Detector with filter (same as above)	

See the detector section for details concerning detectors.

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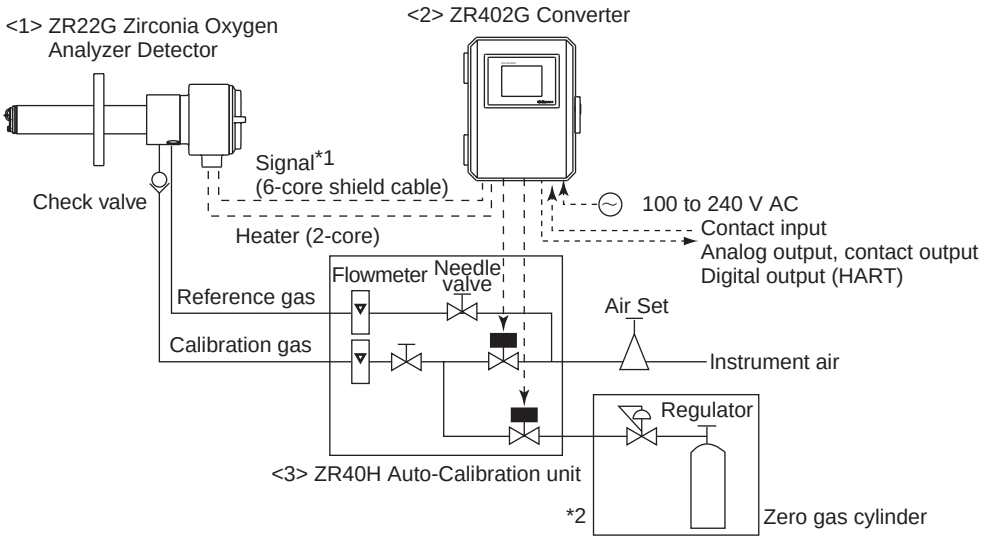
(3) Type: L3 (auto calibration)



Note 1: Shield cable; Use shielded signal cables, and connect the shield to the FG terminal of the converter.
Note 2: When a zirconia oxygen analyzer is used, 100% N_2 gas cannot be used as the zero gas. Use approximately 1% of O_2 gas (N_2-based).

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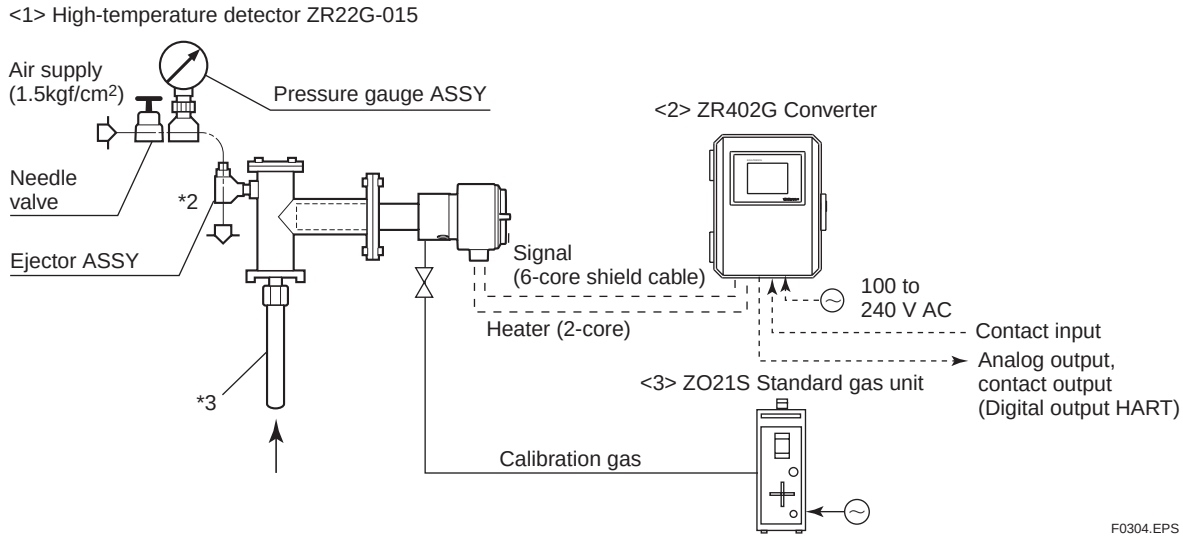
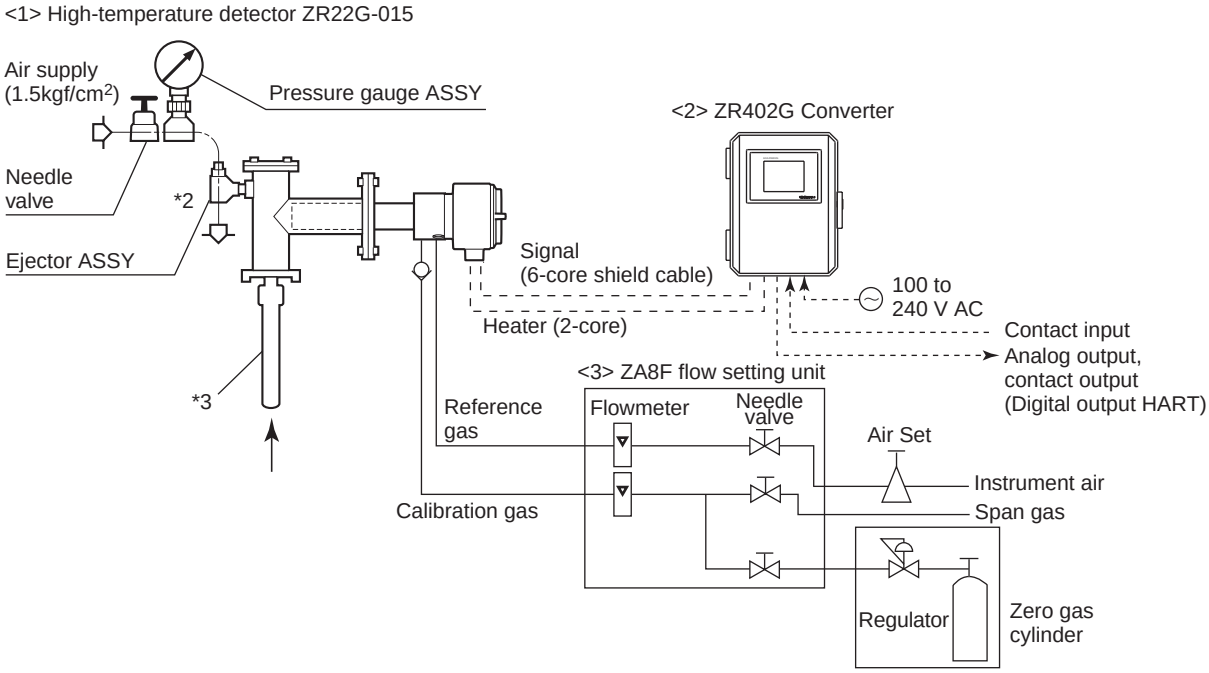
(4) Type: H1 (simple measurement system)



(5) Type: H2 (no auto calibration, no safety purge)



Note 2: Selection of Needle valve or Ejector ●: Necessary

Check	Pressure kPa	Needle valve*1	Ejector ASSY*2	Ejector ASSY*3
	–0.5			●
	–0.5 to 0.05		●	
	0.05 to 0.5			
	0.5 to 5	●		

*1: K9473XH/K9473XJ
*2: E7046EC/E7046EN
*3: consult with YOKOGAWA

Note 3: Selection of high temperature probe material

Check	Mounting orientation / Maximum temperature (°C)	Horizontal mounting	Vertical downward mounting
	800	SUS310S	SUS310S
	1400	—	SiC

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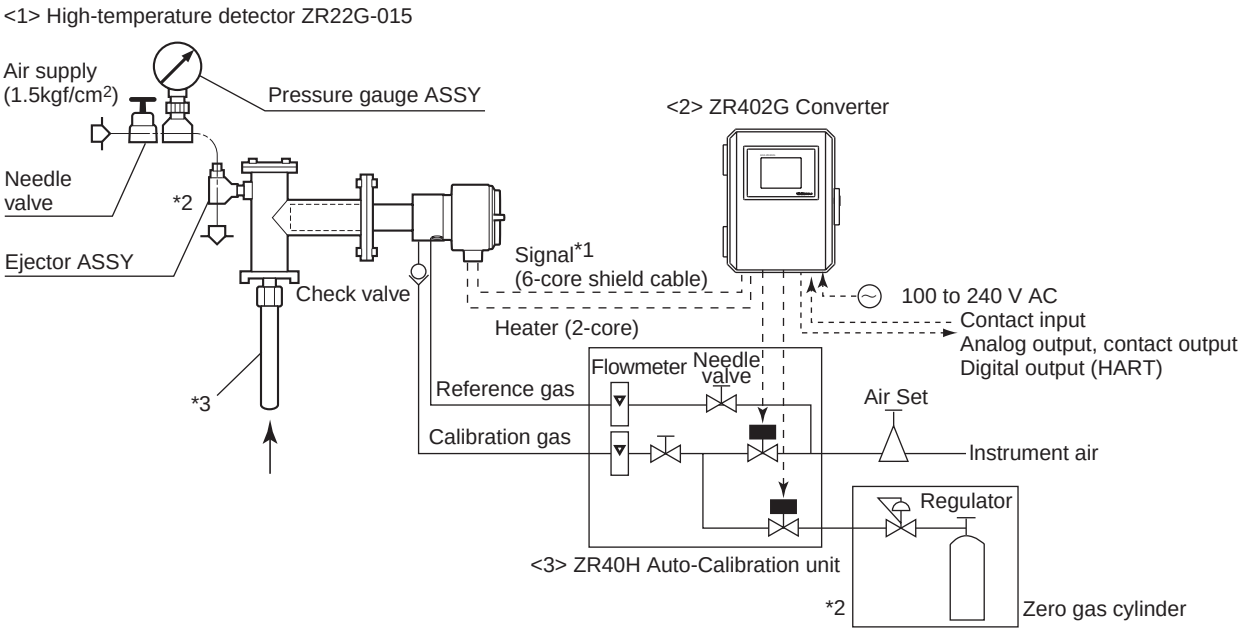
(6) Type: H3 (with auto calibration, with safety purge)



Note 1: Shield cable; Use shielded signal cables, and connect the shield to the FG terminal of the converter.
Note 2: When a zirconia oxygen analyzer is used, 100% N_2 gas cannot be used as the zero gas. Use

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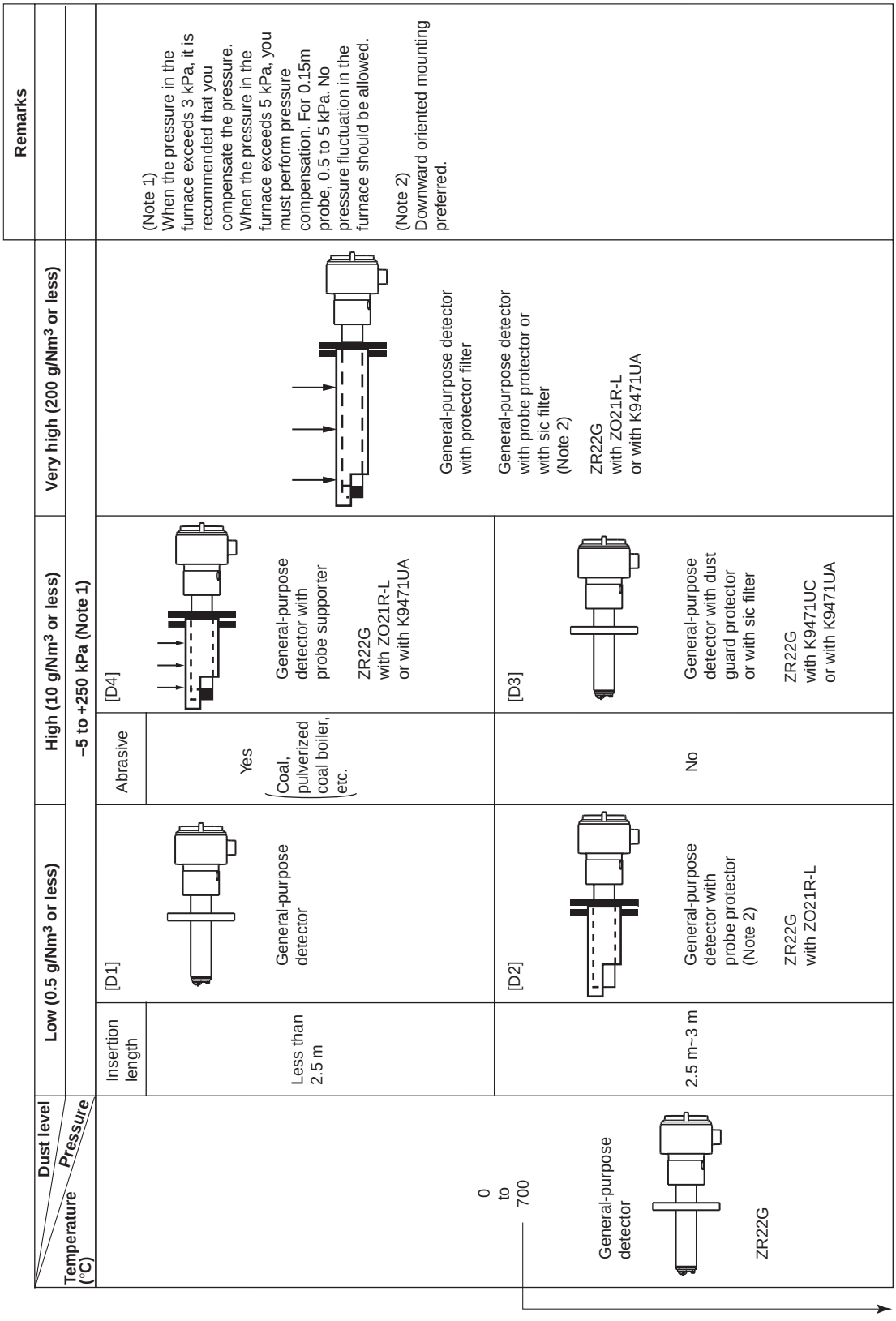
3.3 Examples of System Component Selection Based on Sample Gas Conditions

1) Detector and its accessories


Dust level
Pressure
Temperature (°C)
Low (0.5 g/Nm³ or less)
High (10 g/Nm³ or less)
Very high (200 g/Nm³ or less)
–5 to +250 kPa (Note 1)
Insertion length
Less than 2.5 m
2.5 m–3 m
Abrasive
Yes
(Coal, pulverized coal boiler, etc.)
No
[D1]
General-purpose detector
[D2]
General-purpose detector with probe protector (Note 2)
ZR22G with ZO21R-L
[D3]
General-purpose detector with dust guard protector or with sic filter
ZR22G with K9471UC or with K9471UA
[D4]
General-purpose detector with probe supporter
ZR22G with ZO21R-L or with K9471UA
General-purpose detector with protector filter
General-purpose detector with probe protector or with sic filter (Note 2)
ZR22G with ZO21R-L or with K9471UA
0 to 700
General-purpose detector
ZR22G
Remarks
(Note 1)
When the pressure in the furnace exceeds 3 kPa, it is recommended that you compensate the pressure. When the pressure in the furnace exceeds 5 kPa, you must perform pressure compensation. For 0.15m probe, 0.5 to 5 kPa. No pressure fluctuation in the furnace should be allowed.
(Note 2)
Downward oriented mounting preferred.
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Conditions & specifications: Temperature (°C)	Mounting orientation	Dust level: Pressure kPa: Maximum temperature (°C)	Dust level: Pressure kPa: Probe material	Low (1 g/Nm² or less → Consult us if higher): −0.5 to 0 to +0.05 (Note 1): Auxiliary ejector: Required	Low (1 g/Nm² or less → Consult us if higher): −0.5 to 0 to +0.05 (Note 1): Valve: Not required	Low (1 g/Nm² or less → Consult us if higher): +0.05 to +0.5: Auxiliary ejector: Not required	Low (1 g/Nm² or less → Consult us if higher): +0.05 to +0.5: Valve: Not required	Low (1 g/Nm² or less → Consult us if higher): over +0.5: Auxiliary ejector: Not required	Low (1 g/Nm² or less → Consult us if higher): over +0.5: Valve: required	Remarks
Over 700 Up to 1400	Vertical downward	800	SUS310S	[D5]		[D6]		[D7]		(Note 1) Consult us if pressure is less than −5 kPa
High-temperature detector High-temperature probe adapter	Vertical downward	1400	SiC							
Auxiliary ejector (or needle valve)	Horizontal	800	SUS310S	ZR22G-015 ZO21P-H- E7046EC or E7046EN		ZR22G-015 ZO21P-H-		ZR22G-015 ZO21P-H-	Needle valve not supplied	
ZR22G-015 ZO21P-H- (E7046EC or E7046EN) The high-temperature probe adapter includes a standard material probe.	Horizontal	1000	Inconel 600							
	Horizontal	over 1000	Not possible							

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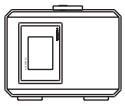
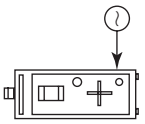
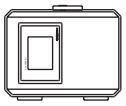
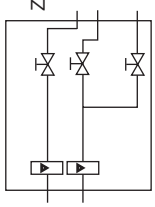
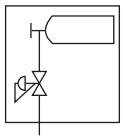
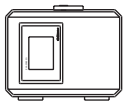
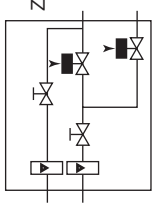
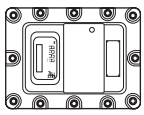
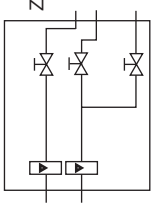
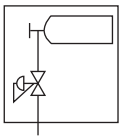
2) Converter and accessories (flow setting unit, calibration gas, etc.)

Use \ Device	Converter	Flow setting unit	Calibration gas	Remarks
General / For monitoring	ZR402G 	None	ZO21S-□-□*A (standard gas unit) 	Minimum configuration for small boiler monitoring, etc.
General / Control/alarming / Without auto calibration	ZR402G 	ZA8F-□*A (air set not included) 	Cylinder: G7001ZC Regulator: G7014XF G7013XF Case: E7044KF 	Most common configuration. Solenoid valve unit for handling unburnt gas in available as an accessory system for petroleum or petrochemical fired heaters.
General / Control/alarming / With auto calibration	ZR402G 	ZR40H (air set not included) 	Same as above	This configuration automates the calibration operation.
Explosionproof / Auto calibration / Not available	ZS8C 	ZA8F-□*A (air set not included) 	Cylinder: G7001ZC Regulator: G7014XF G7013XF Case: E7044KF 	Sometimes required for petroleum and petrochemical, etc. Be sure to use with explosionproof termianl box type detector.

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4. Applications

This section takes up typical application examples for the zirconia oxygen analyzer. These individual applications are structured as follows.

Application examples: Overview of individual devices, and sample points.

Sample gas condition examples: Examples of sample gas conditions, and block diagrams and type numbers for zirconia oxygen analyzer systems to be used under those conditions.

4.1 Boiler

a) Package boiler

This is the most common application. Although the system is generally used for combustion monitoring, there are also cases in which it will be used for VVVF or other such combustion control schemes.

Sample point	System type	Detector	Objective
Boiler furnace outlet or economizer outlet	L1, (L2)	D1, (D2)	Combustion monitoring

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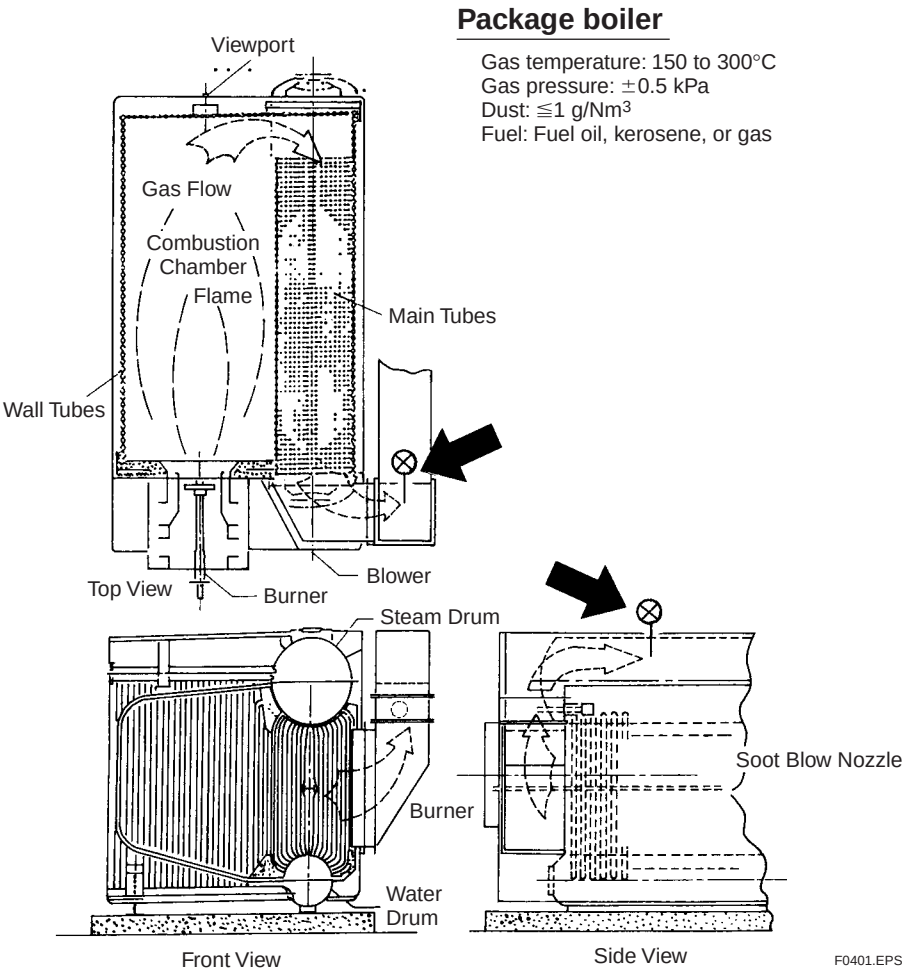

b) Power generation boiler (Heavy oil, Gas)

This is a large-scale facility in which use for combustion control is more common than for combustion monitoring.

In cogeneration, the majority of cases involve measurement at a single point. In electric power companies, measurements are performed at multiple points in a single flue.

Sample point	System type	Detector	Objective
Boiler furnace outlet or economizer outlet	L2, L3	D1, (D2)	Combustion monitoring O_2 control

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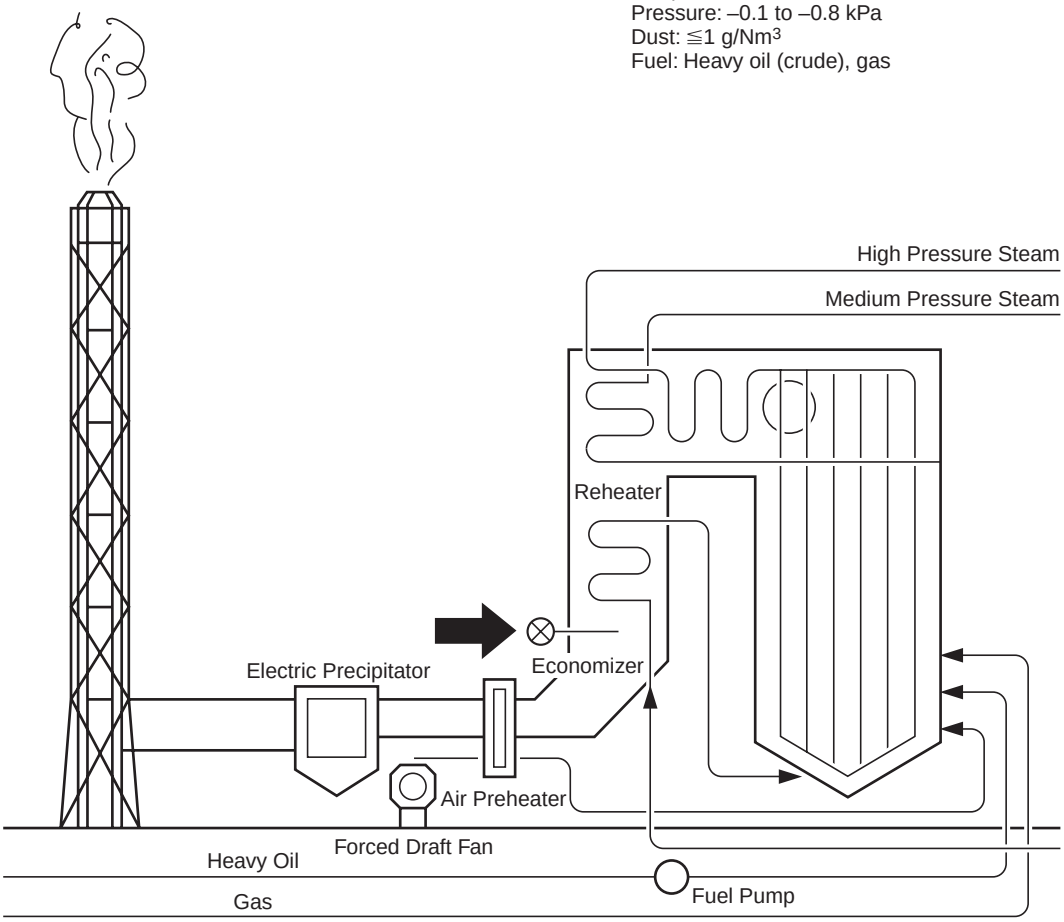
Power generation boiler

Temperature: 250 to 350°C
Pressure: –0.1 to –0.8 kPa
Dust: ≦1 g/Nm^3
Fuel: Heavy oil (crude), gas



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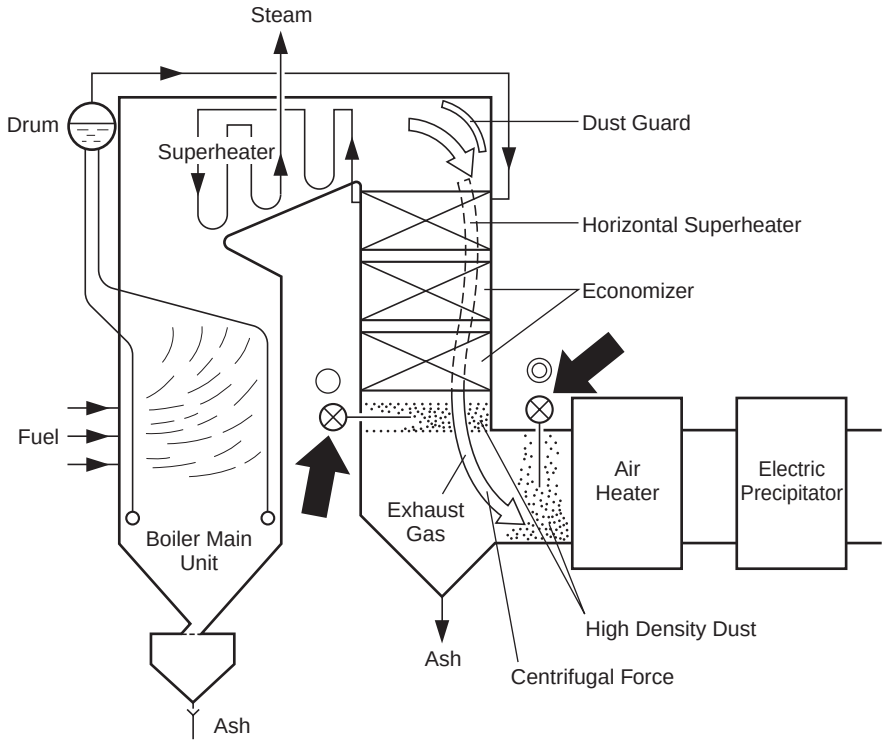
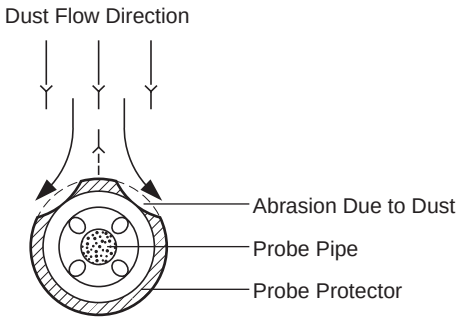
c) Pulverized coal boiler

These are almost always large facilities such as power generation boilers; the O_2 analyzer is used for combustion monitoring and combustion control. Since the exhaust gas entrains a rather large amount of ash dust, a detector with dust protector will be used.

Sample point	System type	Detector	Objective
Economizer outlet (economizer, feedwater afterheater)	L2, L3 (detector with probe protector)	D4	Combustion monitoring O_2 control

T0403.EPS





◎: Optimum mounting position
◯: Second best mounting position

Pulverized coal boiler

Gas temperature: 300 to 400°C
Gas pressure: –1.5 to +1.5 kPa
Dust: Approximately 15 g/Nm^3
Fuel: Pulverized coal

F0403.EPS

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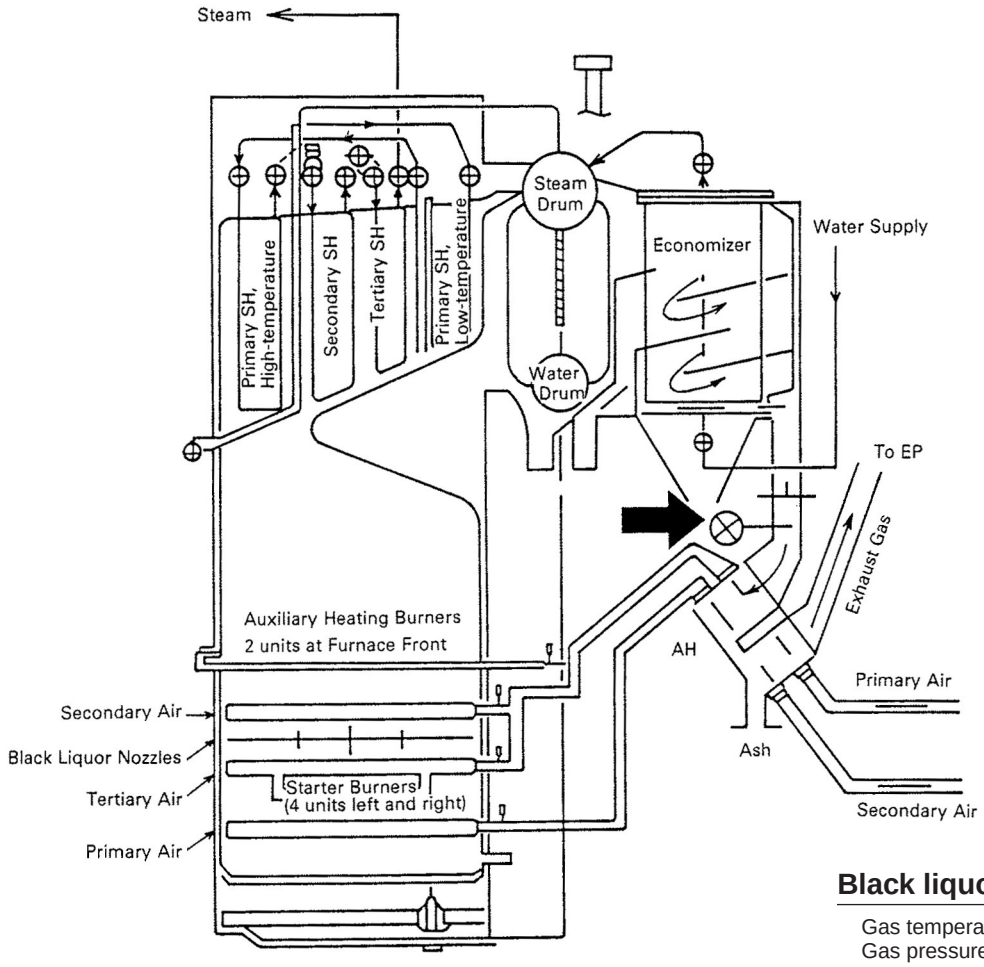
d) Black liquor recovery boiler

The spent liquor in a pulp production process is commonly referred to as “black liquor”. The sodium carbonate and sulfate components in this black liquor are recovered by burning it and using the heat to generate steam. The oxygen analyzer is used to monitor or control the combustion in the combustion facility (boiler). Since the exhaust gas includes large amounts of dust (hydrated sodium sulfate) and water vapor, a detector with filter is selected.

Sample point	System type	Detector	Objective
Economizer: Outlet (economizer, feedwater preheater)	L2, L3 (detector with filter)	D3, (D4)	Combustion monitoring

T0451.EPS



Black liquor recovery boiler

Gas temperature: 170 to 200°C
Gas pressure: +2 kPa
Dust: 6 to 15 g/Nm^3
Main dust components: $Na_2SO_4 \leqq 90\%$
$Na_2CO_3 \geqq 10\%$

F0451.EPS

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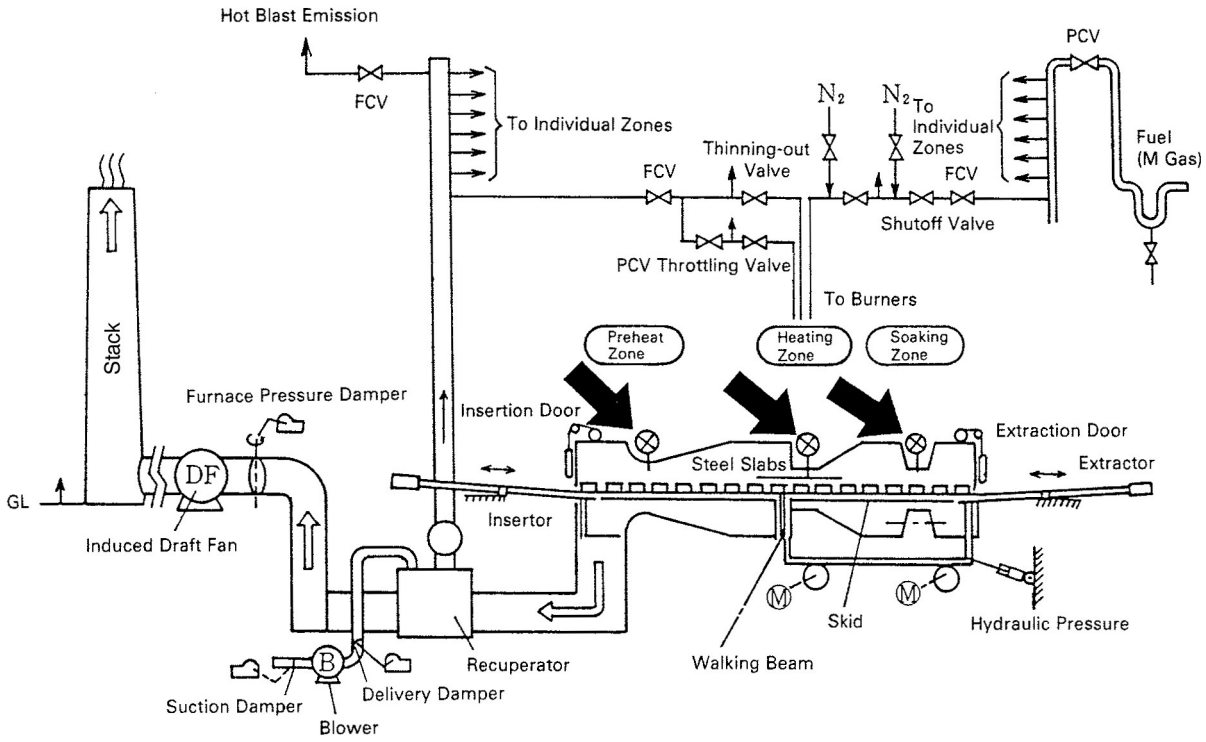
4.2 Iron and Steel Furnaces

a) Iron & steel heating furnace

These furnaces are for the heating of steel slabs, and generally the measured gas is at a high temperature of 1000°C or above. The oxygen concentration is controlled to a low level to prevent oxidation of the slabs. These are also some cases in which there is some amount of CO in the gas, and in which magnetic oxygen analyzers or infrared type CO analyzers are used.

Sample point	System type	Detector	Objective
Preheat zone, heating zone, soaking zone	H2, H3	D5	Combustion monitoring

T0452.EPS



Iron & steel heating furnace

Temperature: 900 to 1400°C
Pressure: 0.03 to 0.05 kPa
Dust: Minute
Fuel: Gas

F0452.EPS

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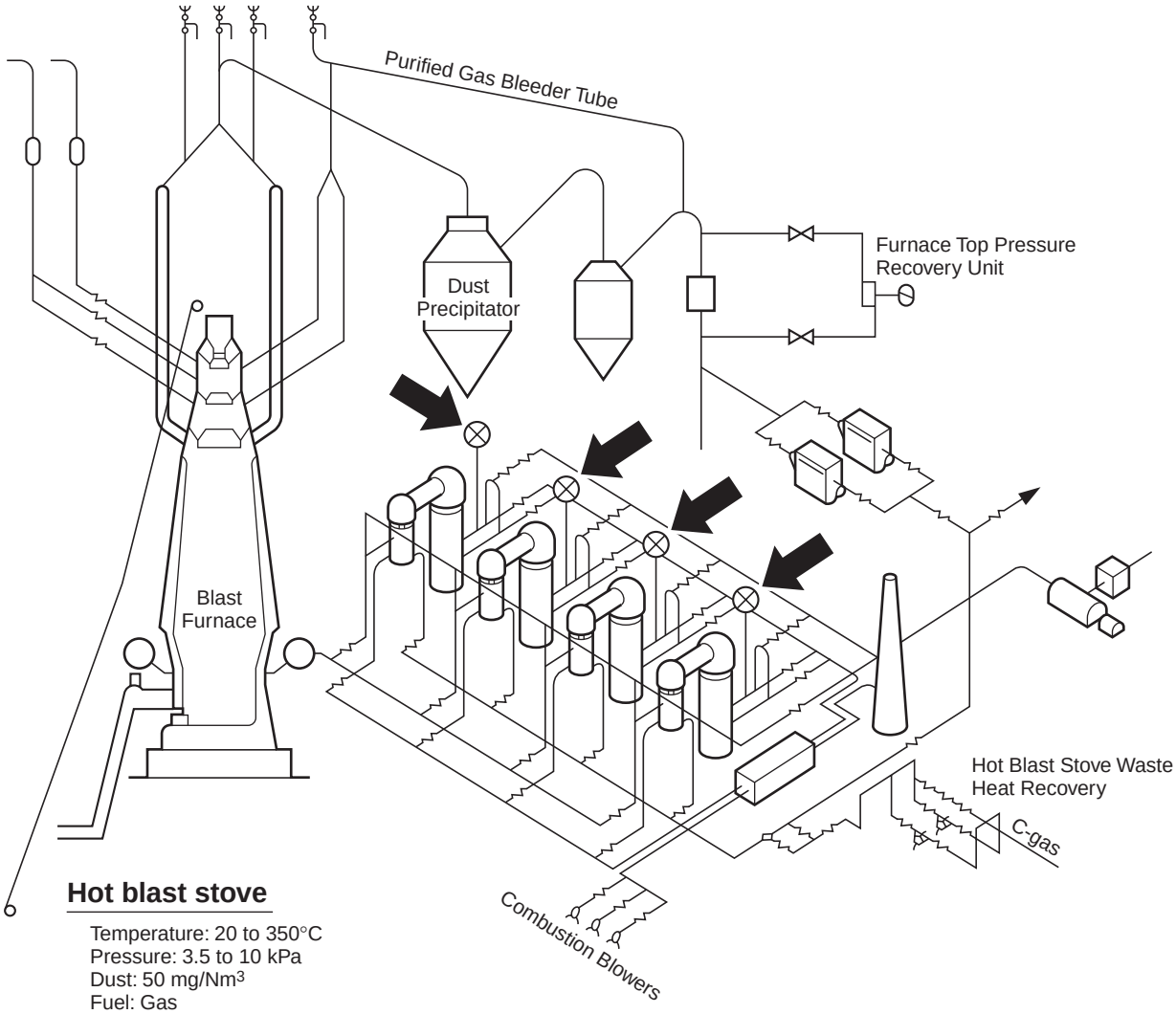
b) Hot blast stove (blast furnace facility)

The hot blast stove is a facility used to heat the air used in a blast furnace to provide the high-temperature hot air blast.

The air is heated by combustion of the gas generated from the coke ovens. The O_2 analyzer is used to control or monitor this combustion.

Sample point	System type	Detector	Objective
Duct	L2, L3 (If pressure is high, a pressure compensated detector is selected.)	D1	Combustion monitoring O_2 control

T0404.EPS



F0404.EPS

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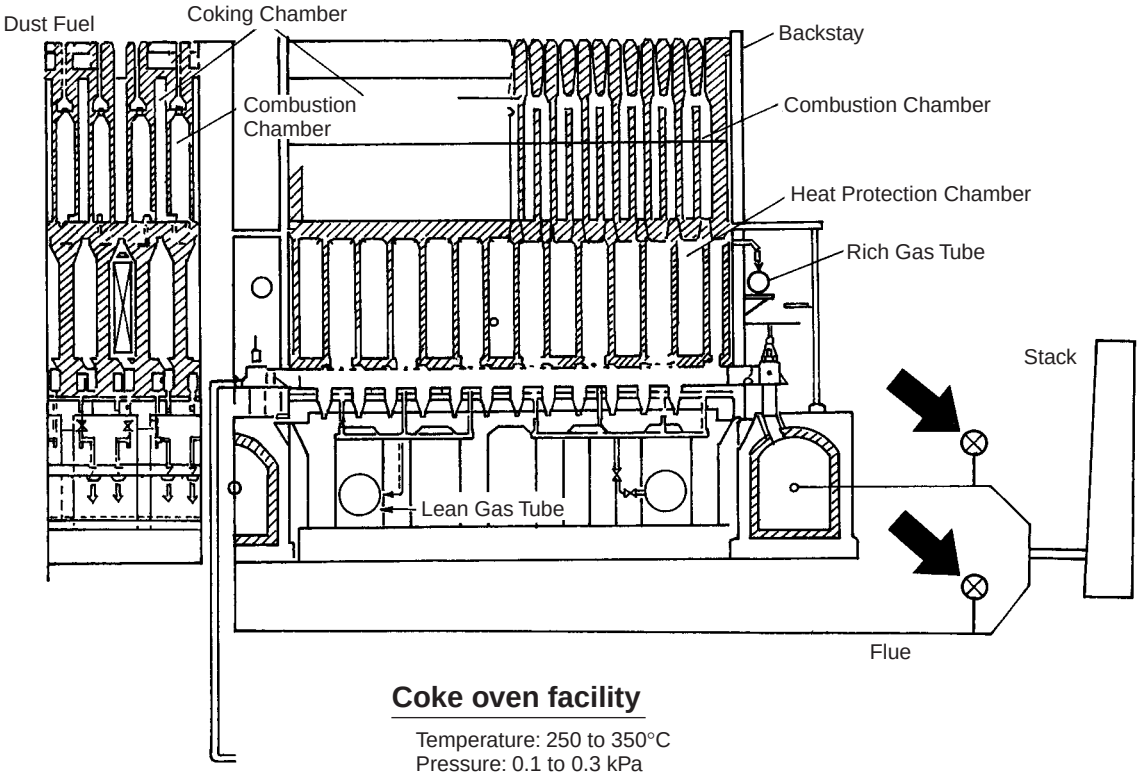
c) Coke oven facility

This facility is used to produce the coke used in the blast furnace.

The O_2 analyzer is used to monitor the exhaust gas from the heater combustion used for destructive distillation of the coal.

Sample point	System type	Detector	Objective
Flue	L2, L3	D1, (D2)	Combustion monitoring

T0405.EPS



Coke oven facility

Temperature: 250 to 350°C
Pressure: 0.1 to 0.3 kPa
Dust: 100 mg/Nm^3
Fuel: Gas

F0405.EPS

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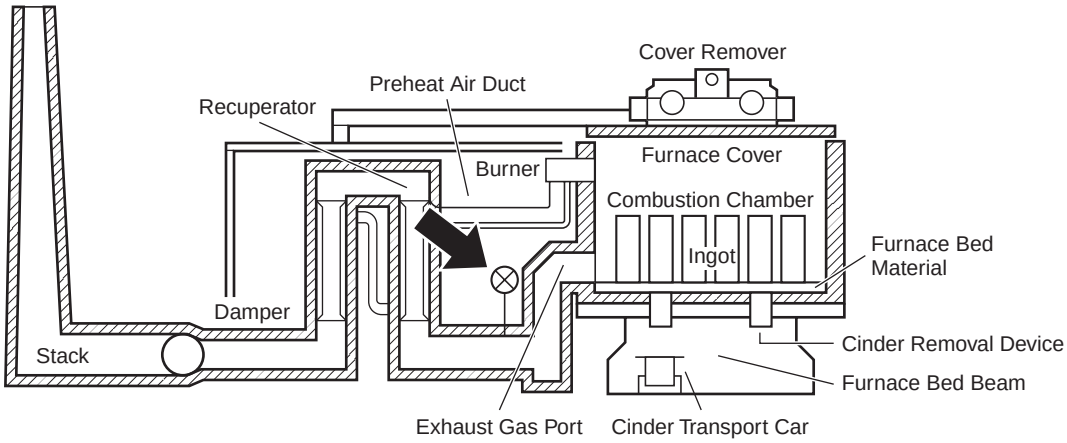
d) Soaking pit

The soaking pit is a type of furnace used to maintain the ingots at a constant temperature. Oxygen concentration is controlled at a low level to suppress ingot surface oxidation.

Sample point	System type	Detector	Objective
Ahead of recuperator	H2, (H3)	D5	Combustion monitoring

T0406.EPS



Construction of unidirectional top section combustion soaking pit.

Soaking pit

Temperature: 1000 to 1200°C
Pressure: 0.03 to 0.05 kPa
Dust: 0.5 g/Nm^3
Fuel: Gas

F0406.EPS

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4.3 Ceramic, Brick, Glass & Cement Furnaces/Kilns)

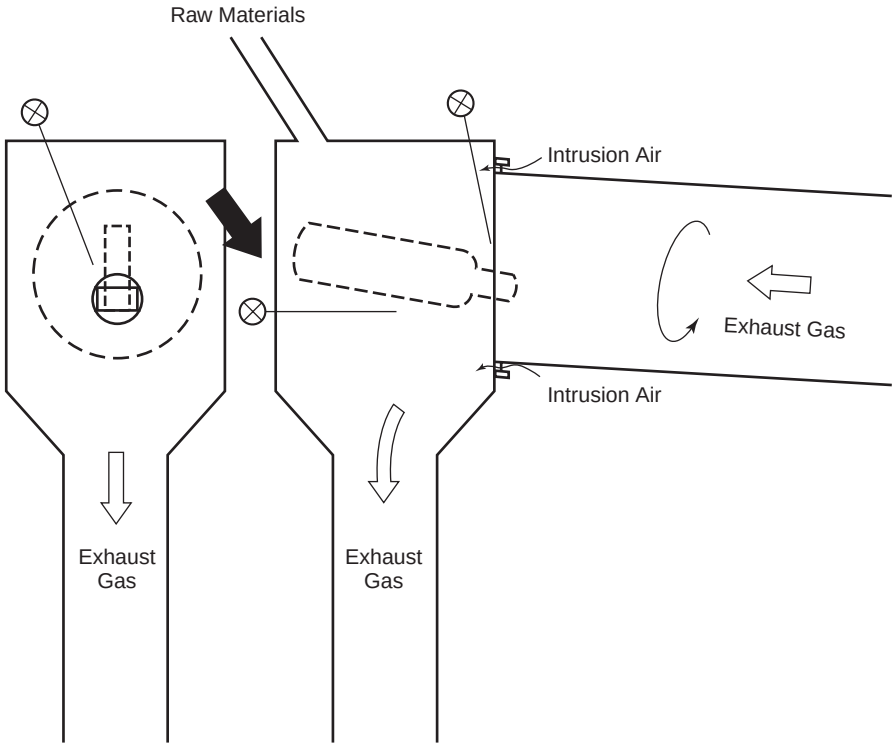
a) Rotary type lime kiln

The O_2 analyzer is used for combustion monitoring to conserve energy.

Careful attention to detector mounting position and orientation is required due to the presence of large amounts of abrasive particulates and intrusion air.

Sample point	System type	Detector	Objective
Kiln end	L2, L3 (H2, H3)	D4 (D3, D5, D6)	Combustion monitoring

T0407.EPS



Rotary type lime kiln

Temperature: 250 to 500°C*1

Note 1: Depending on the kiln, there will be cases when the temperature at the measuring point will be 600°C or greater (600 to 750°C). Under these conditions, the high-temperature type should be used.

F0407.EPS

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b) Cement kiln (cyclone outlet gas)

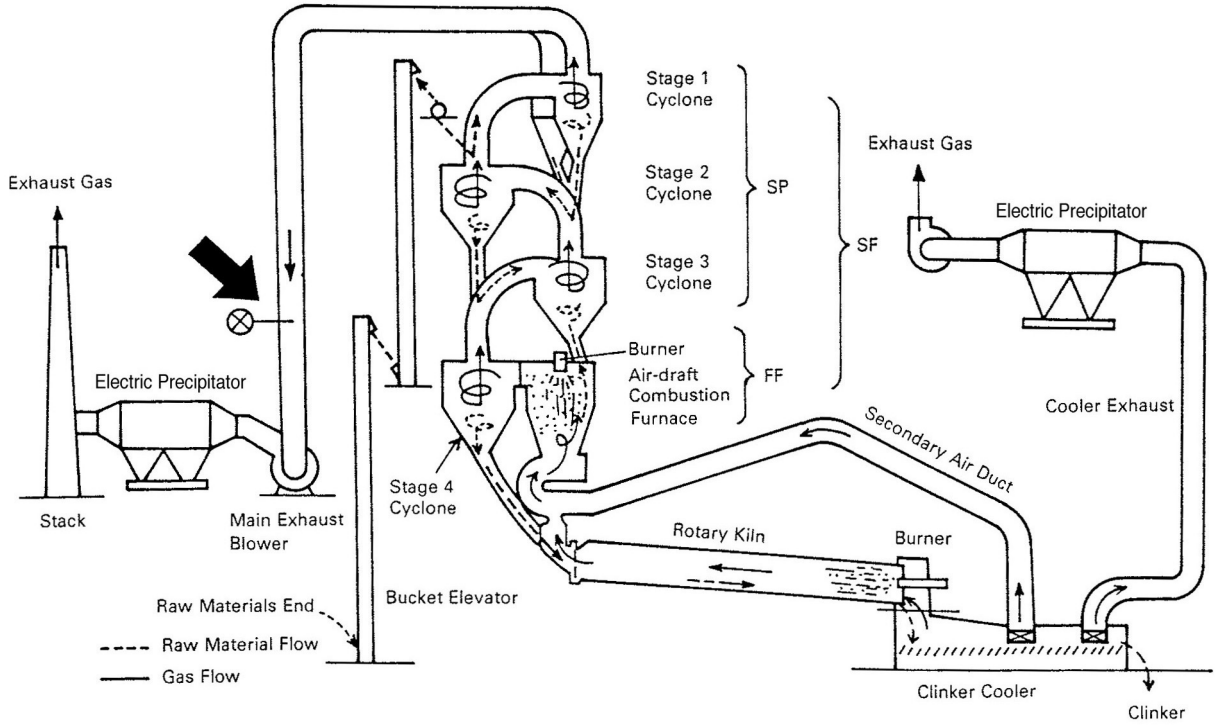
Cement production consumes approximately 100 liters or more of fuel (heavy oil) per ton of cement. Thus, combustion management by means of O_2 analyzers has become a critical element.

There are cases in which O_2, CO, and CO_2 measurements are performed using a sampling system at the kiln outlet.

Sample point	System type	Detector	Objective
Cyclone outlet	L2, L3	D4, (D3)	Combustion monitoring

T0410.EPS

NSP Cement Kiln



Cement kiln

Temperature: 350 to 400°C
Pressure: –3 to 5 kPa
Dust: ≧200 g/Nm^3
CO: ≧0.2%

F0410.EPS

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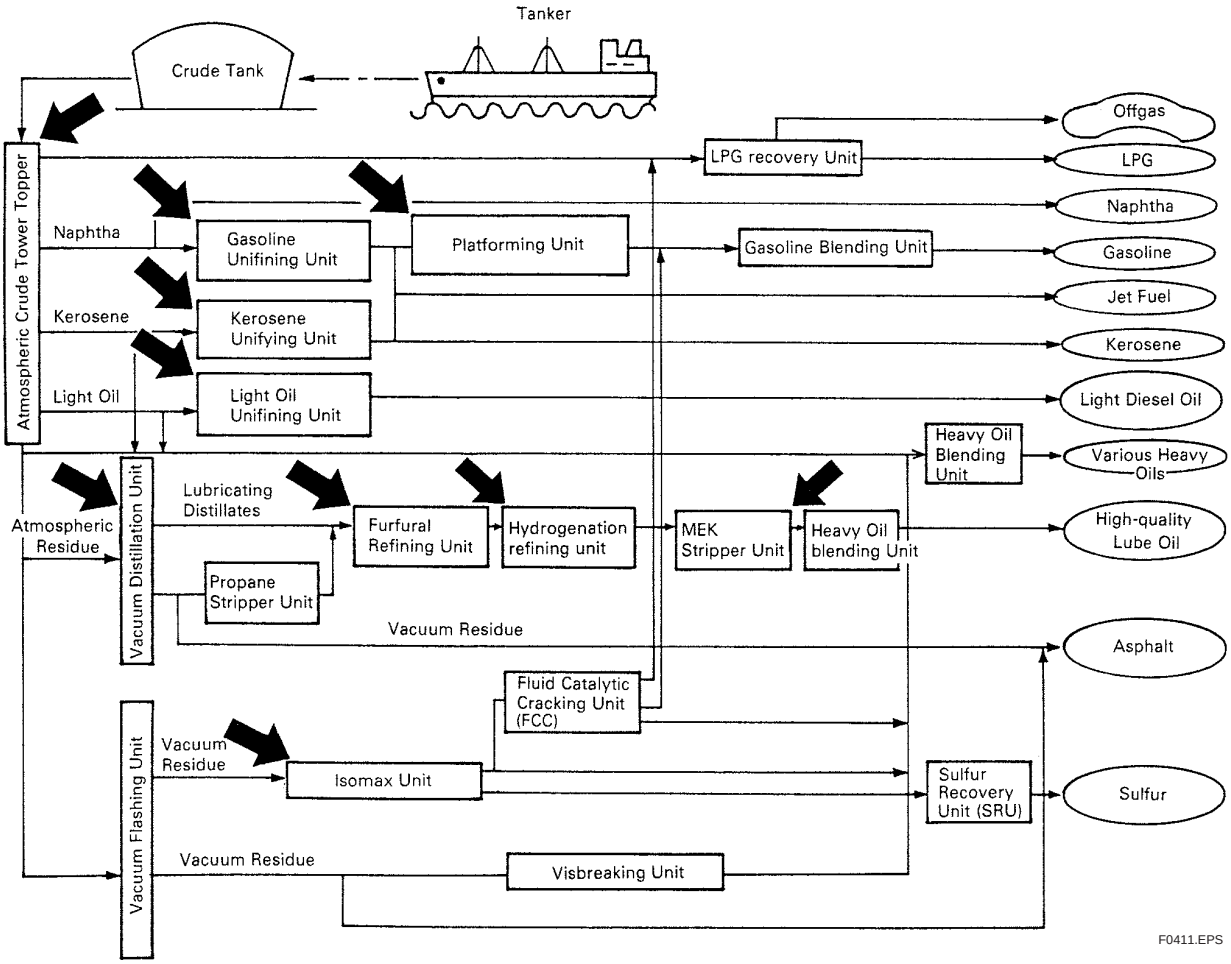
4.4 Petroleum Refining and Petrochemical Fired Heaters

In petroleum refining and petrochemical plants fired heaters are so numerous that you could almost say that there is one in almost every process. Also, since a site consists not of just a single petroleum refining process but rather of ten or more processes, this means that you have that many fired heaters, too (located at the arrows in the diagram above).

In addition to the fired heaters, there will also be a number of boilers. Thus combustion monitoring (or control) is a vital element.



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a) Petroleum refinery process fired heater example

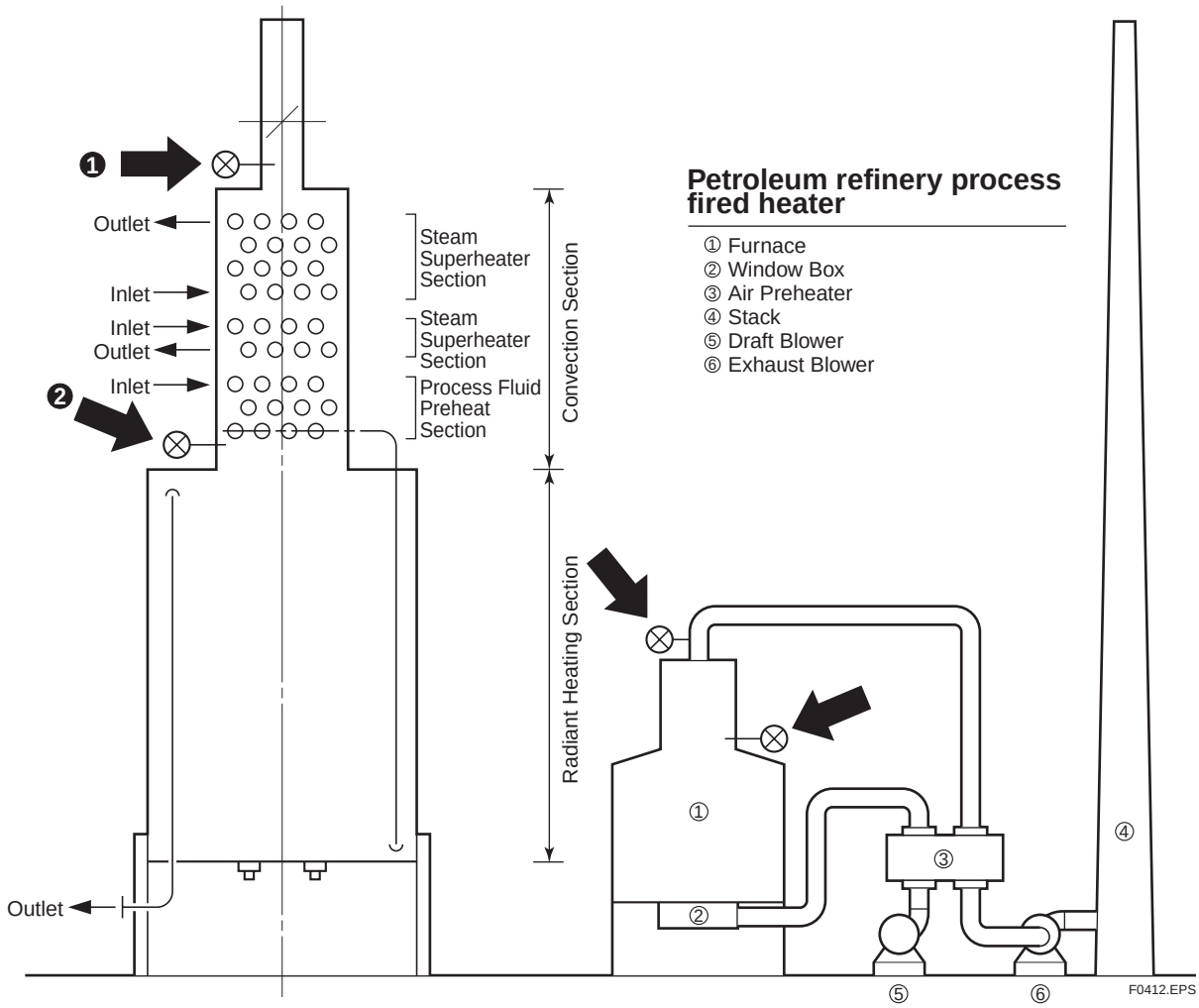
There are two possible locations for the sample point in fired heaters for petroleum refining and petrochemicals: in the stack, or in the vicinity of the furnace outlet (convection zone).

Stack	L2, L3	D1, D2	Explosion proof type with terminal box may also be selected.
Furnace outlet (convection zone)	H2, H3	D5, D6	

T0411.EPS

	Name	Temperature °C
❶ ➡	Stack	Approx. 300 to 500
❷ ➡	Convection	Approx. 600 to 900

T0412.EPS



F0412.EPS

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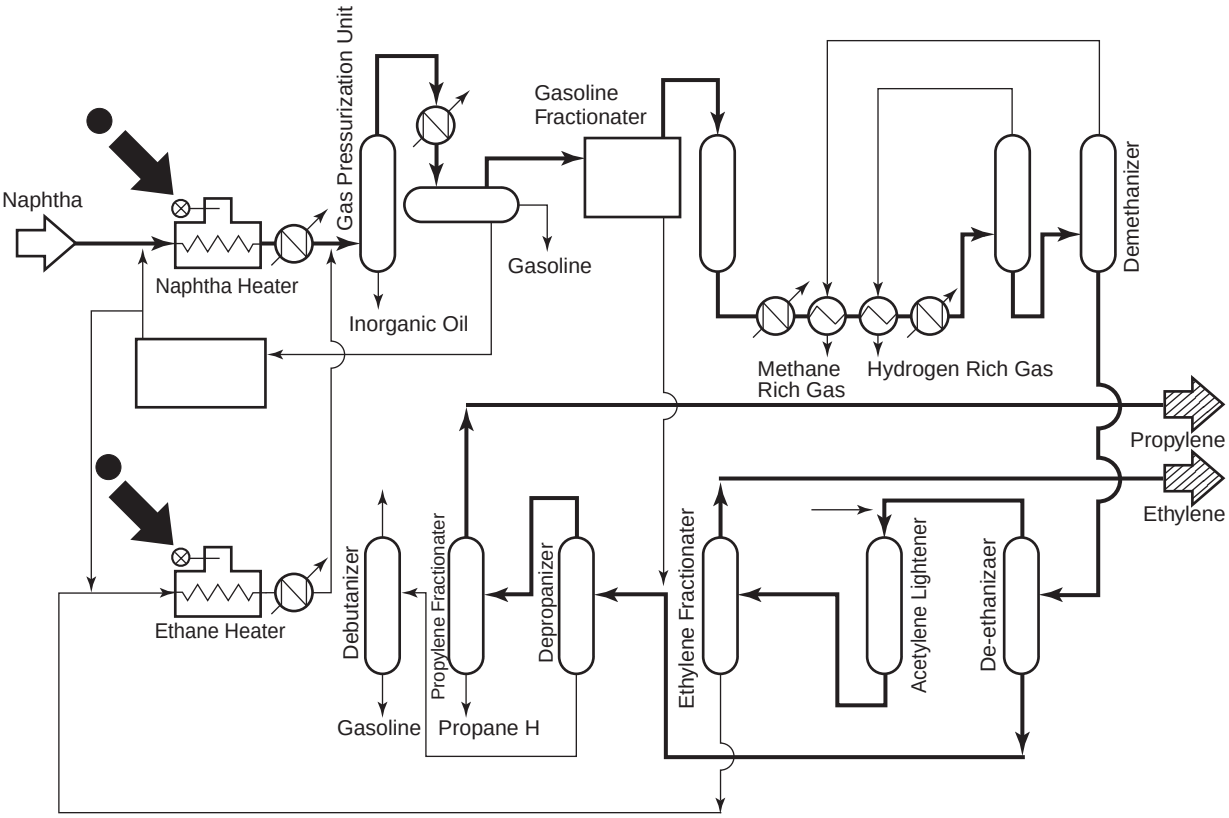
b) Naphtha cracking furnace

This is the first process in a petrochemical facility, in which the Naphtha supplied from the petroleum refinery is heated and cracked to produce a variety of products. There will be not just one but rather anywhere from six to twelve fired heaters, each with its own stack.

Analyzer installation locations		Sample point	System type	Detector	Objective
❶ ➡ ❷ ➡	Fired heaters	Stack or convection	L2, L3 H2, H3 Explosionproof type external terminal box may also be selected	D1, D2 D5, D6	Combustion monitoring

T0413.EPS



Naphtha cracking furnace

Temperature: Stack: 300 to 600°C
Convection: 110 to 600°C
Pressure: –0.2 to 0 kPa
Dust: 1 g/Nm^{3}max.

F0413.EPS

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4.5 Garbage Incinerator

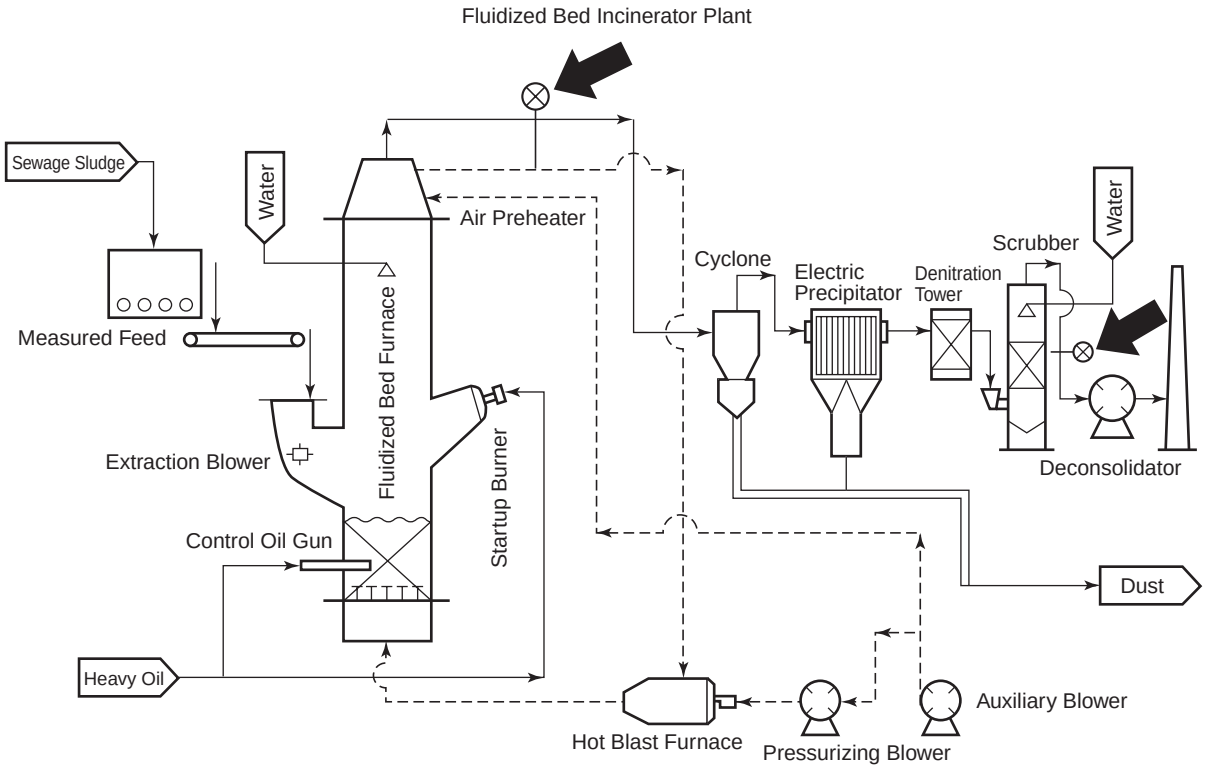
This is a facility to handle by incineration the combustible waste generally contained in municipal garbage.

The exhaust gas of the incinerator outlet contains large quantities of dust and corrosive gasses, and a large water vapor component.

Yokogawa should be consulted concerning the installation of the unit.

Sample point	System type	Detector	Objective
Incinerator outlet (gas cooler outlet)	H2, H3 Note: depending on the conditions at the sample point, a sampling type system may be required.	D5	Combustion monitoring
Scrubber outlet (or stack)	L2, L3	D1, (D3)	Combustion monitoring

T0414.EPS



Garbage incinerator

Incinerator outlet: 700 to 750°C
Exhaust gas temperature: 700 to 750°C
Dust: 20 to 30 g/Nm^3
Exhaust gas components: SOx Several hundred ppm
HCl 100ppm

Scrubber outlet

Exhaust gas temperature: 80 to 120°C
Dust: 0.1 g/Nm^3 maximum

F0414.EPS

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4.6 Non-Combustion Applications

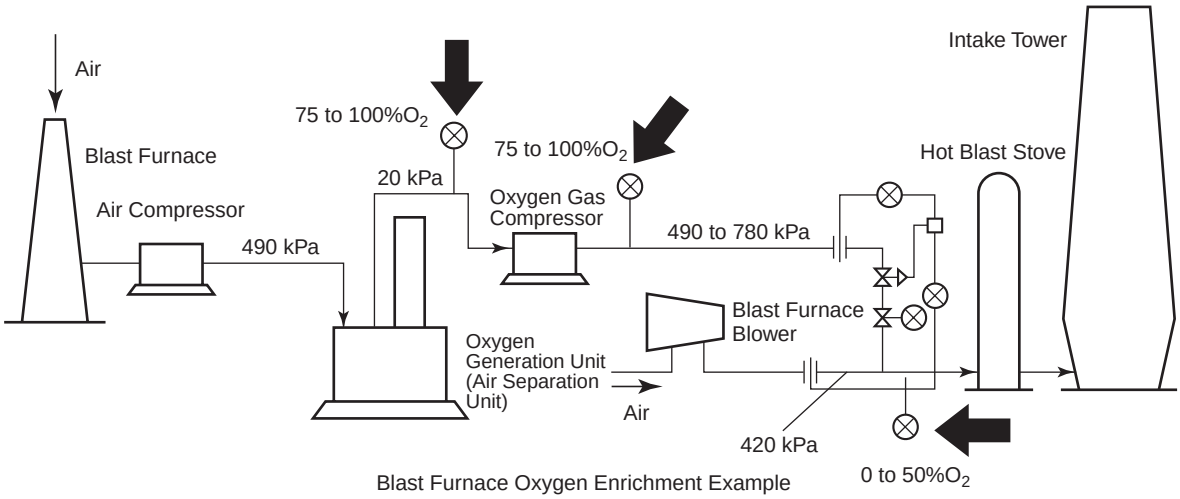
a) Oxygen enrichment facility

Although in most combustion systems air is used as-is, there are cases such as in blast furnaces in steel plants where the air will be enriched with oxygen gas to raise efficiency. When this is done, oxygen analyzers are used to monitor the oxygen generation unit (air separator, etc.), and/or to check the condition of the mixing with the air in later process stages. In these cases, the oxygen analyzer will be measuring values higher than the concentration of oxygen in the air (approximately 21%).

Sample point	System type	Detector	Objective
Oxygen supply line Oxygen compressor outlet	H3 (Note 1)	Note 1	Operational monitoring
Air-oxygen mixing line	H3 (Note 1)	Note 1	Operational monitoring

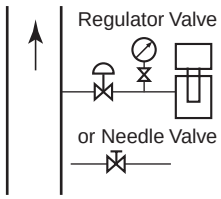
T0415.EPS

Note 1: Measurement will be done using a sampling system, since all the points are at high pressure.



Blast Furnace Oxygen Enrichment Example

Note 1: Due to the high pressure, measurement will be done with a sampling type system.



F0415.EPS

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b) Power generation boiler window box

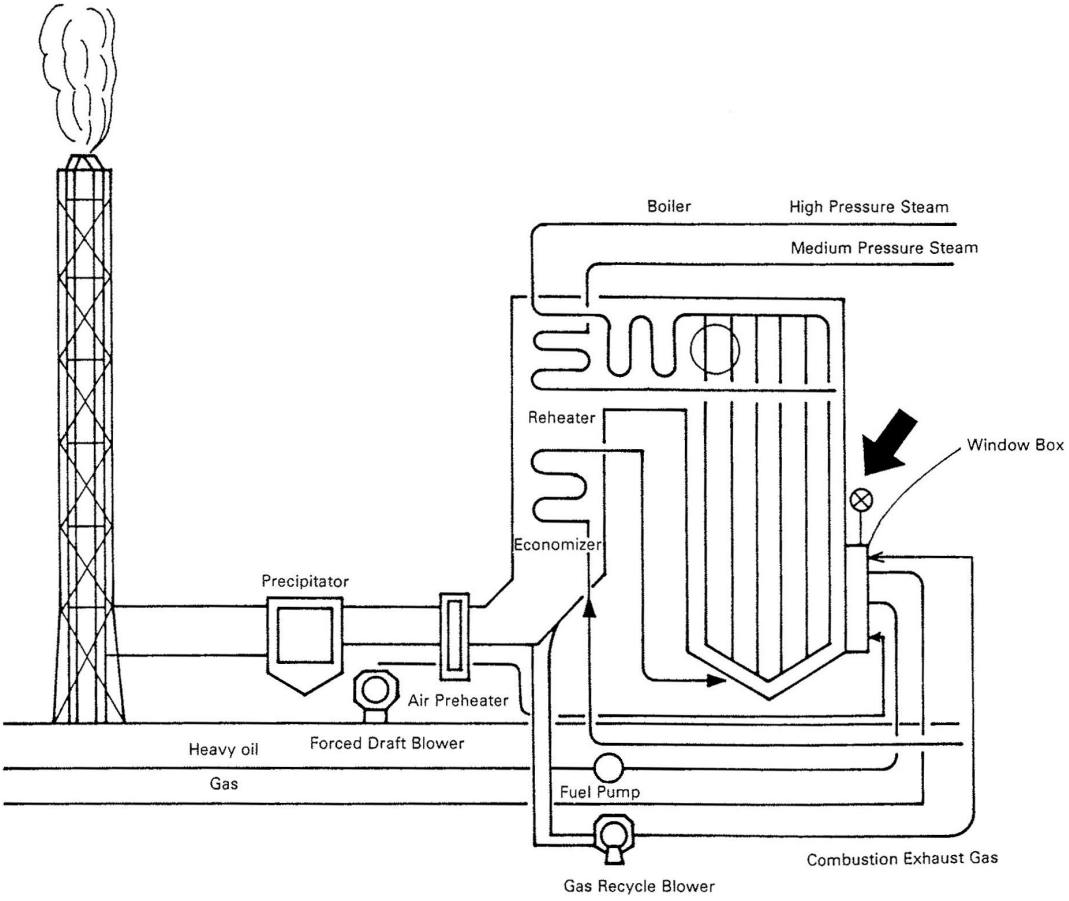
In large boilers such as those for power generation, part of the combustion exhaust gas is recycled to the combustion intake, and the oxygen concentration in the recycled gas is monitored so that it does not drop too low.

The analyzer range will be a partial range that includes the atmospheric oxygen concentration, such as 15 to 22% O_2.

Sample point	System type	Detector	Objective
Window box	L2, L3	D1 (Note)	O_2, control alarm

T0416.EPS

Note 1: The ZO21DW (terminal box explosionproof type detector; pressure compensated type) or the ZR22G (pressure compensated type) will be used. These are many cases in which the AV8C averaging converter will be used.



Power generation boiler window box

Temperature: Max. 550°C
Pressure: –5 to 20 kPa

F0416.EPS

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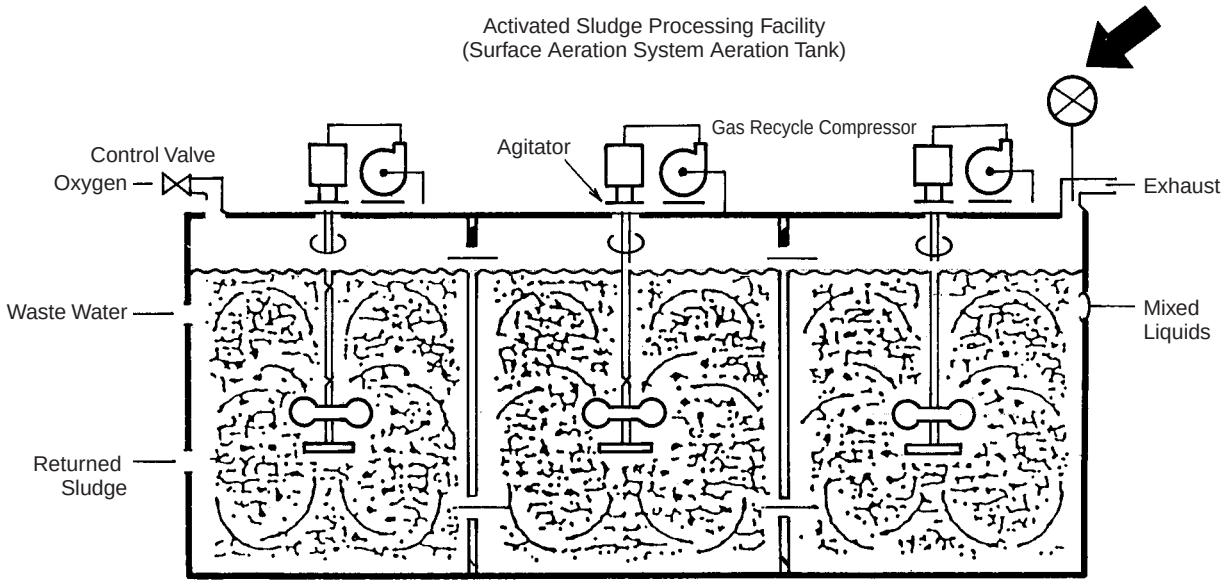
c) Aeration tank

In one type of sludge processing, oxygen gas is introduced into the processing tanks to maintain the dissolved oxygen concentration in the sludge liquid at a proper level. Efficiency is checked by measuring the oxygen concentration in the exhaust gas from the processing tank.

Sample point	System type	Detector	Objective
Exhaust line	L2, L3	D1	Efficiency monitoring & alarm

T0417.EPS



Aeration tank

Temperature: Normal temperature
Pressure: 0 to 1 kPa
Concentration: Approximately 50% O_2 (0 to 100% range)

F0417.EPS

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4.7 Difficult Measurement Applications

a) Glass melting furnace (in-furnace gas)

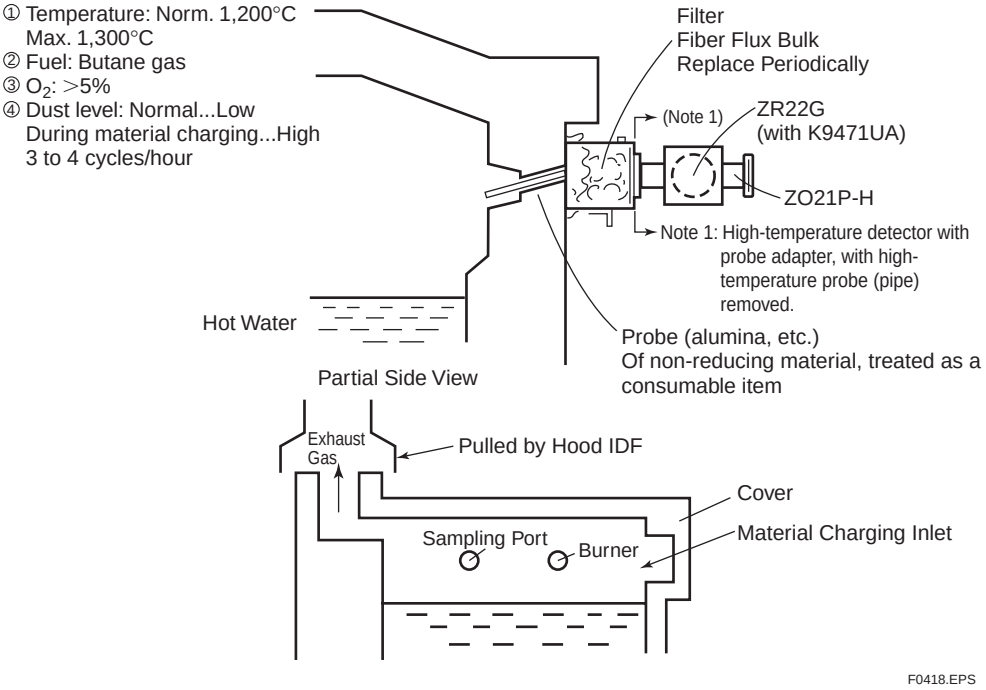
Oxygen concentration in glass melting furnace stacks can be measured with no problems the same as in other general combusion exhaust gas applications.

Glass melting furnace (stack): Temperature 0 to 600°C

System block diagram type No: L2, L3

On the other hand when we come to measurement of the gas inside the furnace, continuous measurement with a direct in-situ zirconia oxygen analyzer (high-temperature system) is either extremely difficult or impossible due to the dust and fumes from the components of the glass. However, since continuous measurements are being performed in some cases by the method shown in the diagram, we offer this for your reference.

Glass melting furnace configuration & with detail of ZR22G installation



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b) Calcinating furnace

Exhaust gas oxygen concentration measurement for fluidized-bed calcination roasting furnaces, sulfur combustion furnaces and other such furnaces which burn sulfur-containing materials or elemental sulfur presents sample conditions such as the following, so direct-in-situ type zirconia oxygen analyzers cannot be used for measurement.

Corrosive gas in exhaust gas: SO_2 7 to 18%

Note, however, that the Yokogawa direct in situ type zirconia oxygen analyzers are fully capable of measurement in exhaust gases containing SO_2 concentrations up to 5000ppm.

c) Facilities with reducing gas atmospheres

The term “reducing gases” refers to those gases which react with metal oxides to reduce them either to metal or to oxides of a lower degree of oxidation. These gases are composed of a reducing component, of which H_2 is the primary example, and an inert gas component such as N_2.

These reducing gases are used for purposes such as protecting metal surfaces from oxidation or dacarbonization during heat treatment, or to improve certain properties. If an attempt is made to use a direct in-situ type zirconia oxyen analyzer in such a metal treatment furnace, the combustible gas (reducing gas) and oxygen in the sample gas will incite a combustion reaction like that shown below in the high-temperature cell section (generally above 600°C), causing a negative measurement error, so that measurement is generally impossible under these conditions.

$2CO+O_2 \rightarrow 2CO_2$

$2H_2+O_2 \rightarrow 2H_2O$

$CH_4+2O_2 \rightarrow CO_2+2H_2O$

Reference

Bulletin 11M12A01-01E

GS 11M12A01-01E

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Inquiry Sheet for Models ZR22G, and ZR402G Direct In Situ Zirconia Oxygen Analyzer

Please place checkmarks in the appropriate boxes and fill in the necessary information in the blanks.

1. General information

Customer

Destination of delivery

Plant name

Measurement points

Object : ☐ indication ☐ record ☐ control ☐ alarm

Fuel : ☐ gas ☐ oil ☐ coal ☐ _____

Power requirements _____V AC _____Hz

2. Process conditions

2.1 Measurement gas components

2.2 Oxygen concentration — Nor. Min. Max. ☐ vol% O_2, ☐

2.3 Temperature — Nor. Min. Max. ☐ °C, ☐

2.4 Pressure — Nor. Min. Max. ☐ kPa, ☐

2.5 Gas flow — Nor. Min. Max. ☐ m/sec, ☐

2.6 Dust type, Size — Nor. Min. μm quantity ☐ g/Nm³, ☐

2.7 Corrosive gas — ☐ No gas ☐ Gas _____ , quantity _____ ☐ ppm, ☐ _____

_____ , quantity _____ ☐ ppm, ☐ _____

2.8 Combustible gas — ☐ No gas ☐ Gas _____ , quantity _____ ☐ ppm, ☐ _____

_____ , quantity _____ ☐ ppm, ☐ _____

2.9 Others _____

3. Installation site conditions

3.1 Ambient temperature — 1. Around Probe temp. from to °C, 2. Around Converter temp. from to °C

3.2 Vibration — ☐ No vibration ☐ Vibration _____

3.3 1 Probe installation location — ☐ Furnace ☐ Stack ☐ Others _____

2 Probe position — ☐ Horizontal ☐ Vertical ☐ Others _____

☐ Indoor ☐ Outdoor ☐ Covered

3 Probe insertion length (m) (Note) — ☐ 0.4, ☐ 0.7, ☐ 1.0, ☐ 1.5, ☐ 2.0, ☐ 2.5, ☐ 3.0, ☐ 3.6, ☐ 4.2, ☐ 4.8, ☐ 5.4

4 Flange — ☐ DIN _____ ☐ ANSI _____ ☐ Others _____

3.4 Instrument air supply — ☐ Cannot be used. ☐ Can be used. _____kPa

3.5 Converter location — ☐ Indoor ☐ Outdoor ☐ Covered (under roof)

3.6 Cable length between probe and converter _____ meters

3.7 Calibration method — ☐ Manual ☐ Automatic

(Note) 3.6m or more is available only in the U.S.

4. Quotation data

Quotation		Qantity	Description
Probe	Model ZR22G General-use Probe		Refer to the GS11M12A01-01E for probe selection.
	Model ZO21P-H High Temperature Use Probe Adapter		
	E7046EC /E7046EN Auxiliary Ejector for high temperature use.		
Options (for general use)	Model ZO21R Probe Protector for Oxgen Analyzer		
	K9471UA Filter for Oxgen Analyzer		
Model ZR402G Separate type Analyzer, Converter			
Model ZO21S Standard Gas Unit			Select any one of ZO21S, ZA8F, ZR40H.
Model ZA8F Flow Setting Unit			
Model ZR40H Automatic Calibration Unit			
L9852CB /G7016XH Stop Valve			Not required if probe options are specified.
K9292DN /K9292DS Check Valve			
G7011XF /E7040EL, G7004XF/K9473XG Air Set			
G7013XF /G7014XF Pressure Regulator			
ZR22A, ZR202A Heater Assembly (Spare Parts)			

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